

## **Catrin Edelbro**

### **Principal Engineer**

<b>Expertise</b>	Rock Mechanics, Mining Engineering, Teaching, Project Management
<b>Education</b>	<p>Ph.D. (Rock Mechanics), 2008 Luleå University of Technology, Luleå, Sweden</p> <p>Licentiate in Engineering (Rock Mechanics), 2004 Luleå University of Technology, Luleå, Sweden</p> <p>M.Sc Civil Engineering with specialization in rock engineering, 1999 Luleå University of Technology, Luleå, Sweden</p>
<b>Professional Affiliations</b>	<p>Board member of the Swedish Commission: IEG 2.0 (Implementing European standards in Geotechnology).</p> <p>Board member of the working group Risk in the Swedish Geotechnical Society.</p> <p>Board member of Task Group Basic requirements in Geotechnics (IEG 2.0).</p> <p>Swedish member of the European initiative in Eurokod 7 and task group: Guidelines on common topics/assembling the ground model since 2021.</p> <p>Member of International Society of Rock Mechanics</p>
<b>Professional Experience</b>	
2022–present	<p><i>KTH Royal Institute of Technology</i> <i>Adjunct Professor in Rock Mechanics and Rock Engineering</i></p>
2021–present	<p><i>Itasca Consultants AB, Luleå, Sweden</i> <i>Principal Engineer</i></p>
2017–2021	<p><i>Itasca Consultants AB, Luleå, Sweden</i> <i>Geomechanical Engineer</i></p>
2015–2017	<p><i>Luleå University of Technology, Luleå, Sweden</i> <i>Deputy Head at Department, part-time</i></p>
2015–2016	<p><i>EIT Raw Materials</i> <i>Interim Education Officer, part-time</i></p>
2013–2017	<p><i>Own consultant company</i> <i>Technical and management support consultant for short projects</i></p>
2012–2014	<p><i>Program coordinator of a 5 year national program: MSc Civil Engineering, part time</i></p>
2011–2012	<p><i>Program coordinator of a 2 year international program: MSc Mining and Geotechnical Engineering, part time</i></p>

2011–2017	<i>Luleå University of Technology, Luleå, Sweden Ass. Professor and Senior Lecturer in Rock Mechanics and Rock Engineering</i>
2008–2012	<i>Head of student recruiting at the Department, part time</i>
2008–2011	<i>Luleå University of Technology, Luleå, Sweden Lecturer in Rock Mechanics and Rock Engineering</i>
1999–2008	<i>Luleå University of Technology, Luleå, Sweden Doctoral Student / Research Engineer, Division of Rock Mechanics</i>
1997	<i>Boliden Trainee</i>

### **Project Experience**

#### *Infrastructure and tunneling:*

Project managing and design work for a water treatment plant in Norway (2022-present).

Internal project management work for the extension of the Stockholm metro in Stockholm (T-central – Nacka, 2021–present).

Responsible rock mechanical engineer, design and project management work for the extension of the Stockholm metro (Akalla – Barkarby, 2017–present) including one unique and complex region with weak and porous rock. The design work includes geomechanical core mapping, rock mass characterization and classification, empirical-, analytical and numerical analysis, ground improvement techniques, ground support design, risk identification, and content in tollgates during excavation.

Risk, design, analysis and project management work for underground railroad stations and tunnels in Gothenburg (2018–2023). Responsible rock mechanical engineer for tunnel constructions during 2019–2021. Responsible for risk analysis work and tollgates during 2018–2021. The design managing work includes, empirical- analytical and numerical analysis, ground improvement techniques, ground support design, risk identification and analysis and description of tollgates.

Interpretation and evaluation of the application of 2nd generation of Eurocode on rock constructions. Investigation work in IEG 2.0 projects which during 2021 considered A3.1 Changes in EN 1997-2, A3.3 Ground Model and A.4 Ground Model. The project A1.2 New concepts and content in Eurocode started late 2021 and will be completed in May 2022.

Responsible editor (2018) for revision of "Projektering av bergkonstruktioner", the design guidelines for rock tunnels by the Swedish Transport Administration.

#### *Mining:*

Project managing and design work on optimal drift size and location in the LKAB Kiirunavaara Mine (2021 – present).

Investigation study for LKAB regarding the bearing capacity of ground support (2022)

Assistant project management work in pre-feasibility and feasibility studies for a new mine (2021 – present).

Benchmark study on ground-based slope radar (2021) and mining and sizes of drifts (2020 and 2021).

Review work for the Boliden Tara Mines in Ireland (2019, 2021, 2023).

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Investigation study for Boliden regarding "Raiseboring in difficult conditions" (2018–2020).

Geomechanical core (oriented) mapping (since 2018).

Geotechnical characterization and ground support design recommendations for future underground crusher facility at the Aitik open pit (2018).

Project manager of "Underground ventilation (a feasibility study)" during parts of 2013–2014. The project was completed for Rock Tech Centre (RTC).

*Hydropower:*

Study of rock foundation issues for one of the largest hydropower dams in Sweden (2017–2021). The work includes monitoring program and investigation of potential remedial measures.

Stability assessment of the rock abutment at the Vargfors hydropower dam including field observations and stability calculations in *UDEC* (2013).

*Nuclear Waste Disposal:*

Specialist in rock mechanics for SKB and the planning of investigations for tunnels and shafts (2018–2019).

Development of design mapping procedures for rock characterization (2017–2019).

*Research and other:*

Investigation and review work in the SMI funded prestudy "Augmented rock mechanics reality in underground mining", during 2023 together with researcher at LTU.

Project leader and research work in the SMI funded prestudy "Probabilistic design for underground and open pit mines" during 2022.

Investigation, management, and review work during 2022-2023 in the BeFo financed project entitled "Spiling in tunnels and portals" together with researcher at KTH.

Investigation and review work in the BeFo financed project entitled "Communication of information and knowledge about geological and geotechnical risks in rock engineering projects" together with researchers at KTH (2021-2025).

Numerical modelling in the BeFo-financed project entitled "Efficient simulation of failure probability" (2021-2023).

Evaluation and interpretation of initial rock stresses for Stockholm and Gothenburg (a BeFo funded project). The work comprised compilation of stress measurement data, as well as analyzing these with a more stringent statistical analysis, and finally to present updated stress domains and stress profiles for the Stockholm and Gothenburg areas.

Funding from BeFo in 2019 for the research project "AR in Augmented Reality applications for rock mechanics purposes". The study was on need assessment of AR in rock mechanics and with focus on underground constructions.

Researcher in the RTC project ORESC (2014–2015). The aim of the ORESC project was to improve the resource efficiency by more detailed resource characterization during all stages in mining.

Project leader of the project "Validation of numerical analysis (a feasibility study)" which was a 9 month project (2011–2012) funded by the Hjalmar Lundbohm Research Centre (HLRC). The objective was to increase the understanding of where, what, when, and how measurements should be performed in order to validate numerical analysis.

*Project management and leadership:*

Experience of project management within small projects that have involved two to eight people, such as research related projects, the extension of the Stockholm metro and feasibility studies. Leadership and management in my role as chairman of Luleå Friidrottsförening (Luleå Athletics) since 2019 and present. Project management experience is also from my time as a PhD-student. I have co-supervised a PhD student at LTU who defended his work and became PhD in 2017.

Experience of project management for large projects with more than 8 people or partners involved:

- Deputy head of the Civil, Mining and Environmental Engineering Department at Luleå University of Technology with more than 350 employees. Head of more than 20 education programs at the Department. Strategic program development, stakeholder meetings etc. was included in the role as deputy head.
- Driver and member of the steering committee for implementation of Conceive Design, Implement and Operate (CDIO) at all engineering programs at LTU (2015–2017).
- Head responsible for student recruiting at the department of Civil, Mining and Environmental Engineering for four years which included contact with staff, students and industry and with high focus on time planning and allocation of resources.
- Initiator and leading coordinator for the EIT Raw Material funded project: "Implementation of CDIO in Raw Material MSc program" (2016–2017) with nine partners (LKAB, RISE, Rusal, Aughinish, Clausthal TU, Delft TU, UP Madrid, Chalmers, U Limerick and LTU) and with totally 5900 hours for the partners. The first initiative in the world to implement CDIO in Raw Material MSc programs. Supported the project with arranging a workshop, create a case from industry and a stakeholder meeting during 2017–2018.
- As Interim Education Officer within EIT Raw Materials I was in the role of coaching and boosting networking between academia and industry. This included several workshops, meetings and events in different locations and countries within Europe. Hence a wide experience from collaboration and networking among typical mining related partners in Europe.

Courses linked to project management and leadership that I have participated in at LTU are "Att handleda och handledas" (2005), the development program "Nyfiken på ledarskap" (2011-2012) and "Ledarskap för pedagogiskt ansvariga" (2016).

*Teaching and Academic Experience:*

Four certificates (a total of 13 hp) from pedagogic courses at LTU.

Guest lecturer in rock mechanics at KTH (2019, 2020, 2021, 2022). Guest lecturer at Chalmers and LTU (2020, 2021).

Examiner and teacher for three to seven rock mechanics and rock engineering courses per year (2008–2017) at Luleå University of Technology. The courses have thus been a mix of theory and "practical" work. Teacher in rock mechanics course and tunneling course at LTU, as an Itascan, during 2017–2018.

Supervision of more than 20 undergraduate thesis projects – e.g., blasting of rock slopes, tunnel stability investigation, evaluation of smart cable bolts, improved tunnel contour, strength of backfilling, application of digital photogrammetry for underground tunnel mapping, geotechnical domaining, seismicity in the Fabian orebody, evaluation of oriented rock cores, comparison between 2D and 3D modelling, and underground mining design projects.

Program coordinator of a 5 year national - and a 2 year international program (2011-2014 ) (Civilingenjör Väg och vatten and MSc Mining and Geotechnical Engineering).

Program manager and teacher of the Sandvik International Mining School (2012, 2013 and 2014). The main focus of the program was mass mining and rock mechanics. During my time as coordinator, LTU was ranked as the top University by the Sandvik students. The other education institutions were: Montanuniversitaet in Austria, Camborne School of Mines in UK, University of New South Wales in Australia, Colorado School of Mines in USA and University of the Witwatersrand in South Africa.

Teacher at a diploma programme (2015, 2016, 2019, 2020, 2021, 2022) given at distance (at my own company before 2017). The focus area was rock and mining engineering such as drill and blast unit operations, ventilation etc.

Coordinator and teacher for contract education for the mining company LKAB (2012). The focus area was rock mechanics. Teacher at MiningTech, CENTEK, Luleå in 2000 and 2001.

Awarded as the best teacher at Luleå University of Technology in 2010 with the following motivation (in Swedish): "*Med hennes energi och inlevelse får hon studenter att bry sig, inte bara om sina studier, utan även om sin och andras framtid*".

*Other:*

Board member of the programme board for MSc in Civil Engineering with specialization in Mining and Geotechnical Engineering at Luleå University of Technology, Luleå, Sweden (since 2019 – present).

Member of reference group for the Ultrabult II project at LTU (Led by Johan Carlson at LTU and Anton Jansson at Swerim) (since 2018 – present).

Council member of the Swedish rock engineering foundation (BeFo) (2012–2017).